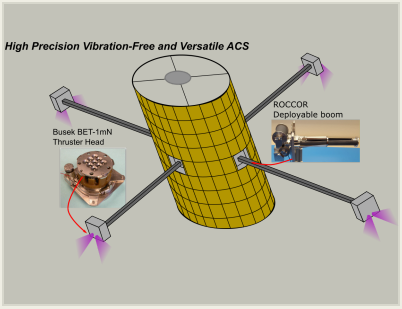
Versatile Attitude Control Actuators for Sub-Milliarcsecond Precision Pointing, Phase I

Completed Technology Project (2017 - 2017)

Project Introduction

Growing scientific and practical needs exist for precision spacecraft pointing at milliarcsec (mas) levels. Present state-of-the-art reaction wheels, or similar, actuators introduce vibrational jitter and can ultimately drive pointing error. Busek electrospray thrusters aboard the ESA LISA Pathfinder mission have recently demonstrated nm scale position control. The proposed system will provide vibration-free sub-mas pointing control through integration of follow-on innovations and new deployable boom technologies. Recent thruster innovations have dramatically increased maximum thrust, while retaining control resolution, and reduced propellant loads through increased specific impulse. These gains will be applied in this work to replace reaction wheel actuators for both precision control and slew maneuvers. Accordingly, actuator induced vibrations are virtually eliminated while body pointing will be dramatically improved; resulting in major reductions in ACS SWaP and in the complexity of vibration compensating controllers/active sensors. With applications to, for example, observation and laser communication missions these benefits would both enable high-capability but reduced cost spacecraft and pave the way for new, presently, unobtainable levels of control authority on large spacecraft. Phase I will emphasize acquisition and analysis of precision thrust control measurements using the BET-1mN thruster-head which, uniquely, can be operated in either a high thrust, low Isp, or low thrust, high Isp configuration. The associated complex performance map will be analyzed in the context of highly quiescent ACS needs. These data will then be applied to define necessary control, circuitry and mechanical requirements needed to realize the full-attitude control potential of the technology. A conceptual system level design performed in collaboration with ROCCOR will outline strategies to overcome required developments and produce a complete system demonstration in Phase II.



Versatile Attitude Control Actuators for Sub-Milliarcsecond Precision Pointing, Phase I Briefing Chart Image

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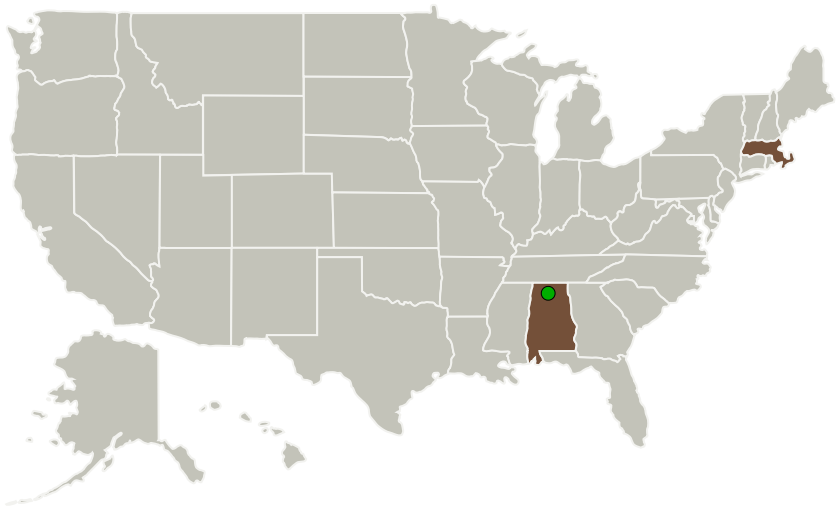
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Busek Company, Inc.	Lead Organization	Industry Women-Owned Small Business (WOSB)	Natick, Massachusetts
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Massachusetts

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Busek Company, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

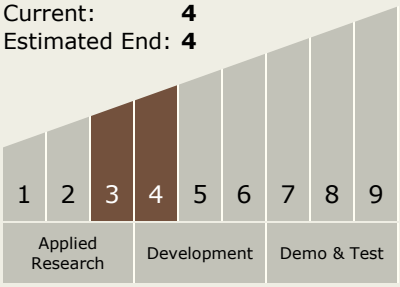
Carlos Torrez

Principal Investigator:

Nathaniel Demmons

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



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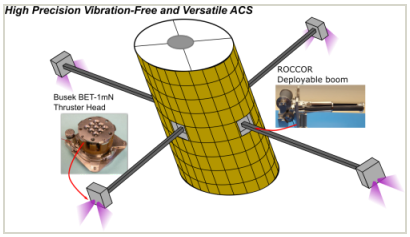
Images



Briefing Chart Image
Versatile Attitude Control Actuators for Sub-Milliarcsecond Precision Pointing, Phase I Briefing Chart Image
(https://techport.nasa.gov/image/133933)

Technology Areas

Primary:

- TX17 Guidance, Navigation, and Control (GN&C)
  - TX17.3 Control Technologies
    - TX17.3.4 Control Force/Torque Actuators